

# Initial Tests of a MEMS Undulator at the ATF

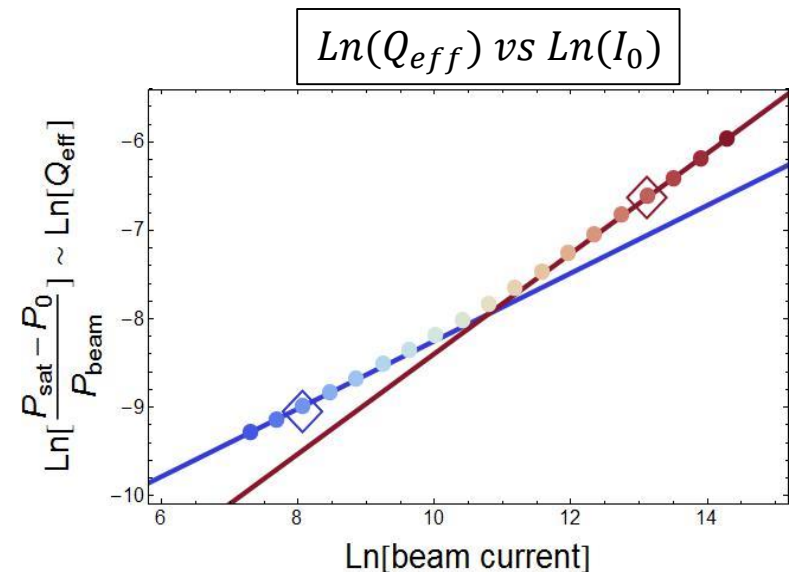
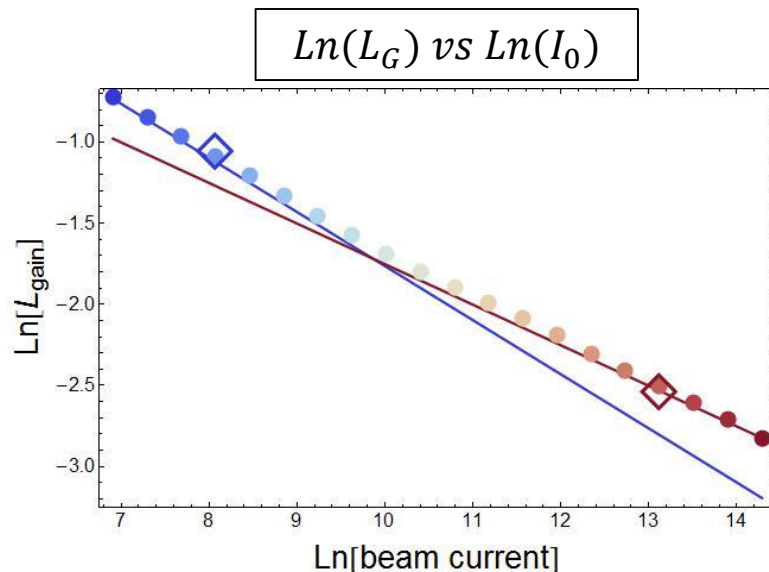
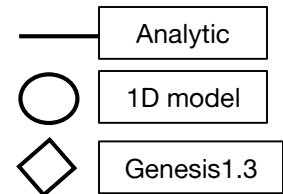
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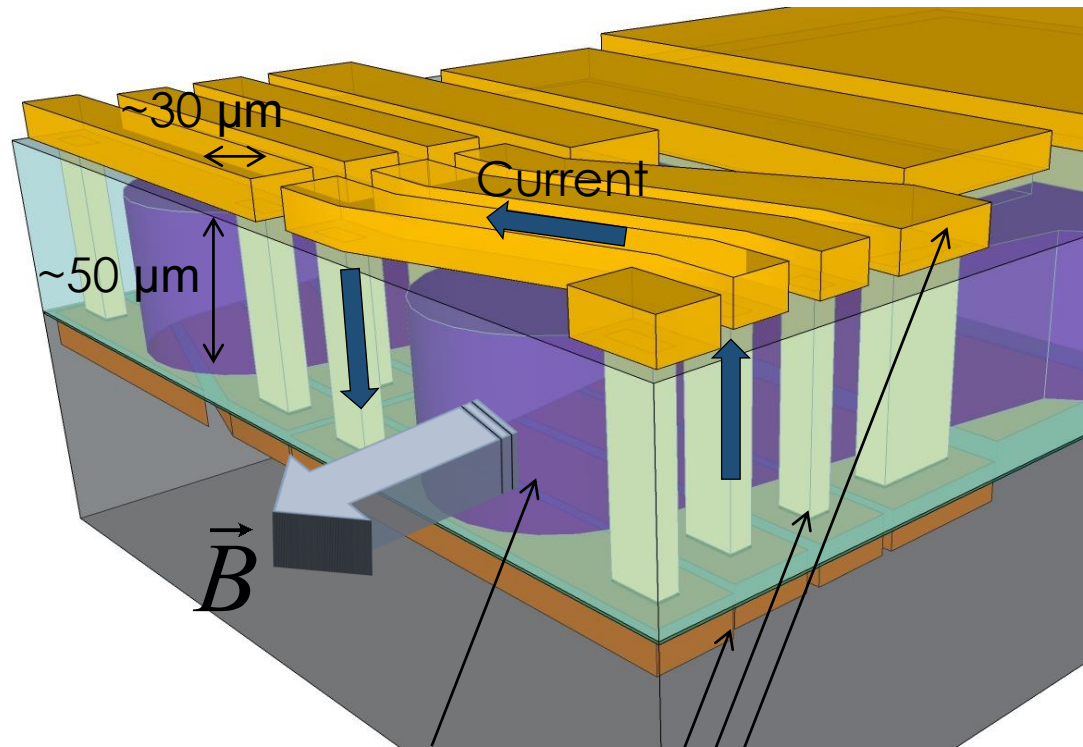
# FEL Raman Regime

- Emerges in FELs with high beam currents and weak coupling between the electrons and the radiation
- Longitudinal space-charge effects come the forefront
  - $2k_p L_G > \pi$
  - Plasma wavelength is on the order of a gain-length

	Gain-Length	Efficiency
Compton	$L_G^C = \frac{1}{2\sqrt{3}k_u\rho} \propto I_0^{-1/3}$	$Q_{eff}^C \propto I_0^{1/3}$
Raman	$L_G^R \propto I_0^{-1/4}$	$Q_{eff}^R \propto I_0^{1/2}$



# MEMS Undulator Fabrication

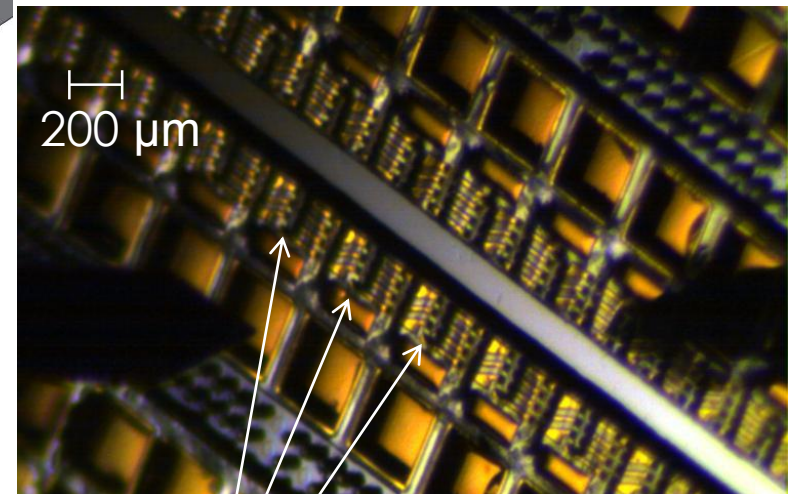


Soft magnet  
core

Windings

**Micromachined electromagnets  
fabricated at UCLA**

Potential for  **$\sim 1 \text{ T}$  fields**  
 **$kT/m$  field gradients**  
controlled in  $\mu\text{sec}$  or  
better timescales



Batch-fabricated Electromagnets

# Testing the MEMS Undulator at ATF

- Look for undulator synchrotron light at ATF
  - Detect with soft x-ray MCP
- Take cue from the DWA experiment performed by G. Andonian et al. [4]
  - Similar dimensions of slab-symmetric stricture and undulator
- Elegant simulations show that focusing through the undulator is possible with the quad triplet upstream of the plasma chamber

## Beam and undulator parameters

Beam Energy	65 MeV
Beam Charge	1 nC
Transverse Size	$\sigma_x \times \sigma_y$ $= 45 \times 31 \mu m$
Beta Function	$\approx 10 cm$
Undulator period	$800 \mu m$
Gap	$200 \mu m$
K parameter	0.08
Central wavelength	$24.9 nm$ $= 49.9 eV$
Bandwidth	$\frac{1}{N_u} = 0.01$
Opening angle	$\theta_{rad} = \frac{1}{\gamma \sqrt{N_u}}$ $= 0.79 mrad$

